

Transport Layer

- Introduction: transport-layer services
- Multiplexing and demultiplexing
- Connectionless transport: UDP
- Principles of reliable data transfer
- Connection-oriented transport: TCP
- Principles of congestion control
- TCP congestion control
- Evolution of transport-layer functionality

COMPSCI 453 **Computer Networks**

Professor Jim Kurose

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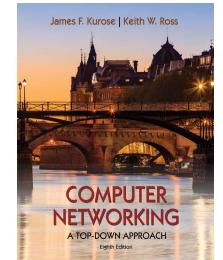
University of Massachusetts



Class textbook:
Computer Networking: A Top-Down Approach (8th ed.)

J.F. Kurose, K.W. Ross
Pearson, 2020

http://gaia.cs.umass.edu/kurose_ross



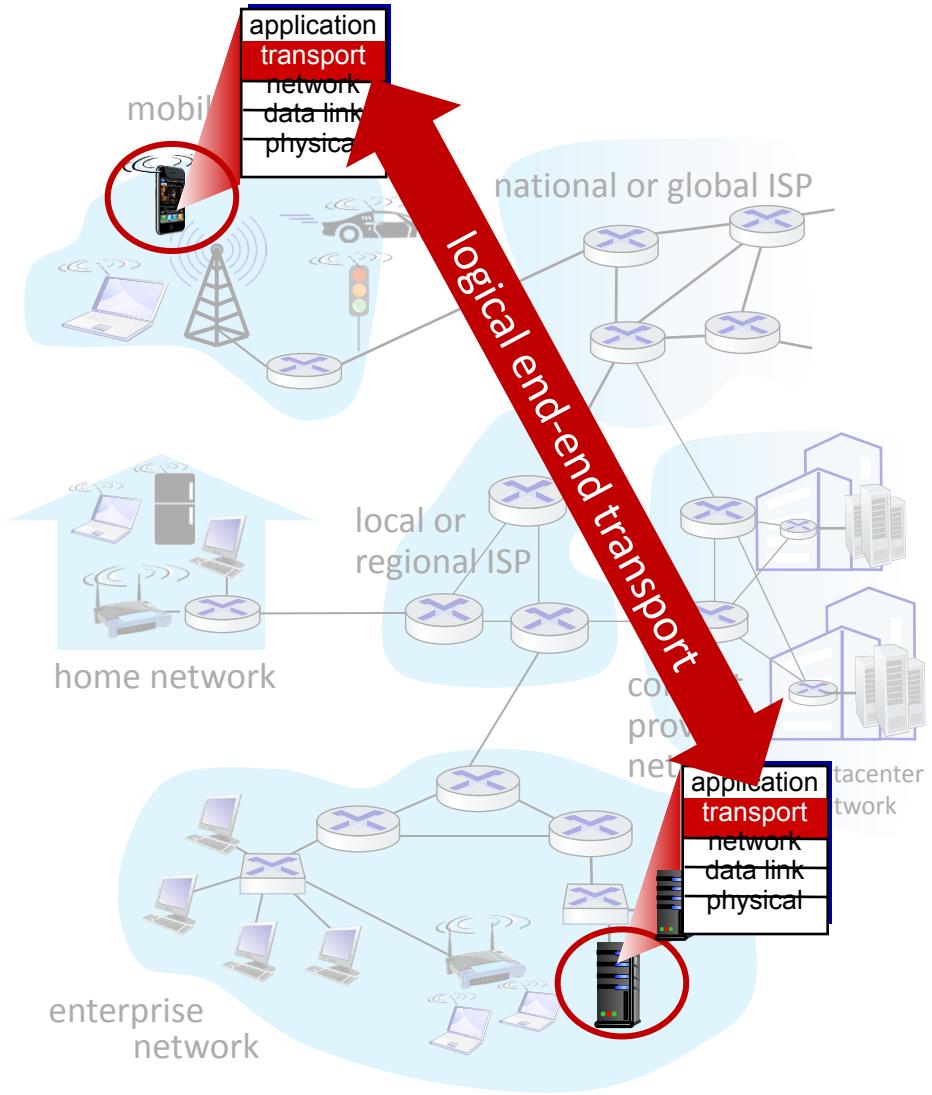
Transport layer: overview

Our goal:

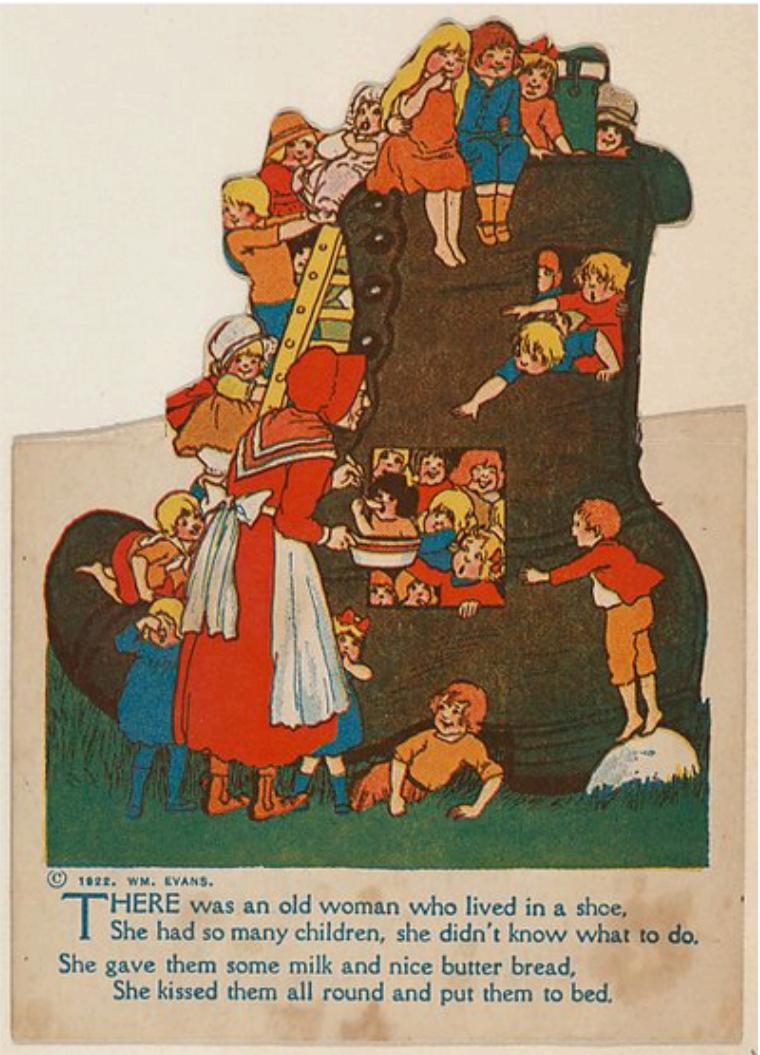
- understand principles behind transport layer services:
 - multiplexing, demultiplexing
 - reliable data transfer
 - flow control
 - congestion control
- learn about Internet transport layer protocols:
 - UDP: connectionless transport
 - TCP: connection-oriented reliable transport
 - TCP congestion control

Transport services and protocols

- provide *logical communication* between application processes running on different hosts
- transport protocols actions in end systems:
 - sender: breaks application messages into *segments*, passes to network layer
 - receiver: reassembles segments into messages, passes to application layer
- two transport protocols available to Internet applications
 - TCP, UDP



Transport vs. network layer services and protocols



household analogy:

12 kids in Ann's house sending letters to 12 kids in Bill's house:

- hosts = houses
- processes = kids
- app messages = letters in envelopes
- transport protocol = Ann and Bill

Transport vs. network layer services and protocols

- **network layer:** logical communication between *hosts*
- **transport layer:** logical communication between *processes*
 - relies on, enhances, network layer services

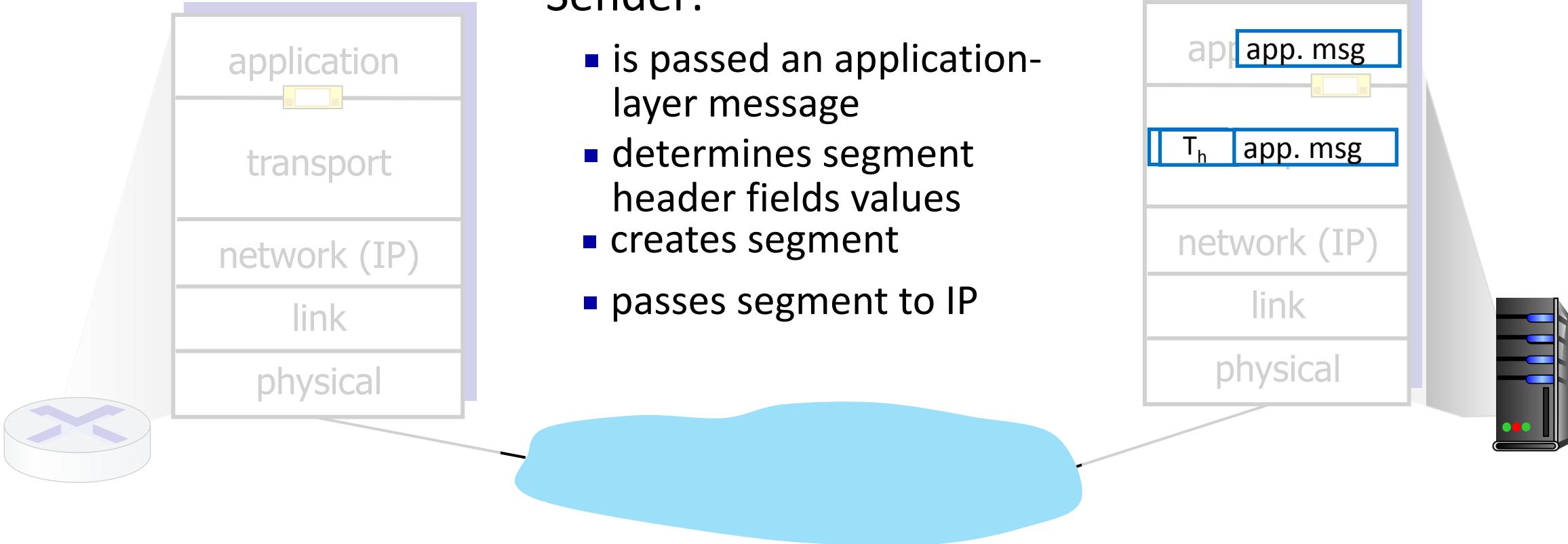
household analogy:

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Transport Layer Actions

Sender:

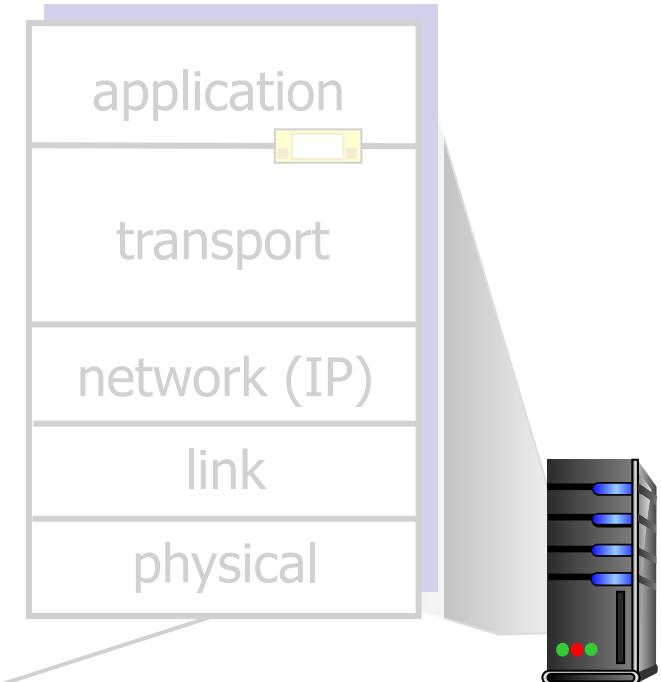
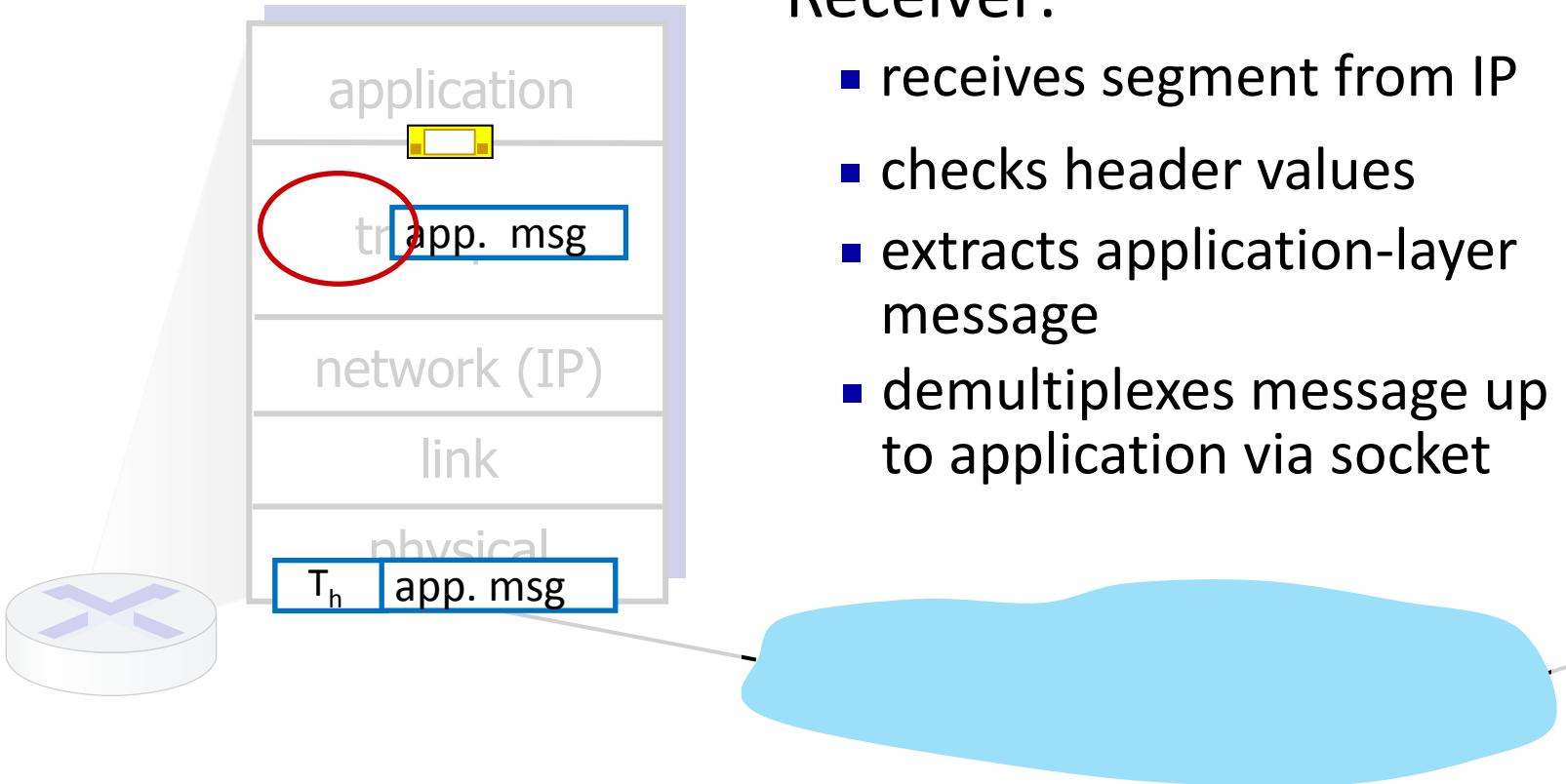
- is passed an application-layer message
- determines segment header fields values
- creates segment
- passes segment to IP



Transport Layer Actions

Receiver:

- receives segment from IP
- checks header values
- extracts application-layer message
- demultiplexes message up to application via socket



Two principal Internet transport protocols

- **TCP:** Transmission Control Protocol

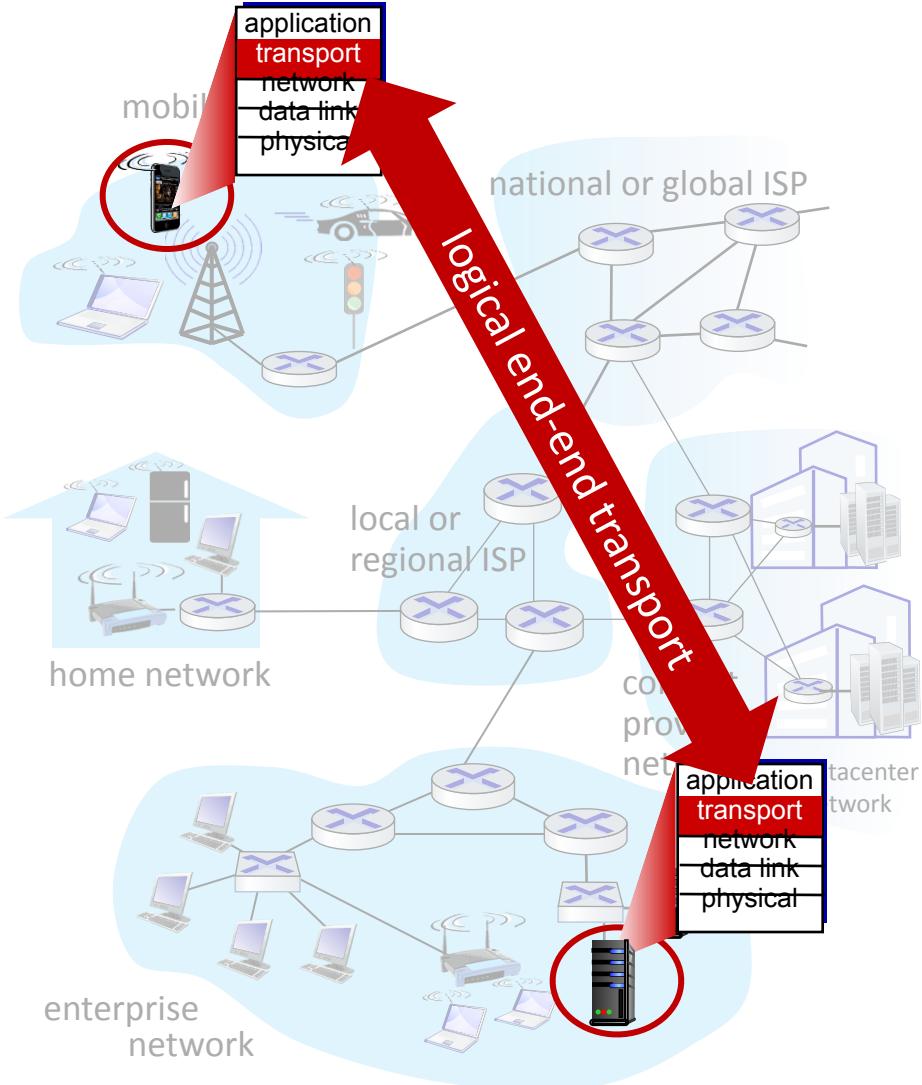
- reliable, in-order delivery
- congestion control
- flow control
- connection setup

- **UDP:** User Datagram Protocol

- unreliable, unordered delivery
- no-frills extension of “best-effort” IP

- services not available:

- delay guarantees
- bandwidth guarantees



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